MICROMACHINED SILICON WAVEGUIDE CIRCUITS

W.R. McGrath[1], J. Wright*, S. Tatic-Lucic[2], Y.-C. Tai[2], C. Walker[3], M. Yap*

[1]Center for Space Microelectronics Technology, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109

[2]Dept. of Electrical Engineering, California Institute of Technology, Pasadena, CA 91125

[3]Dept. of Astronomy, University of Arizona, Tucson, AZ 85726

Rectangular waveguides are commonly used as circuit elements in remote-sensing heterodyne receivers at millimeter wavelengths. The advantages of waveguides are low loss and mechanical tunability. However conventional machining techniques for waveguide components operating above a few hundred GHz arc complicated and costly. Waveguides micromachined from silicon however would have several important advantages including low-cost; small size for very high frequency (submillimeter wave) operation; high dimensional accuracy (important for high-Q circuits); atomically smooth walls, thereby reducing *rf* losses; and the ability to integrate active and passive devices directly in the waveguide on thin membranes, thereby solving the traditional problem of mounting thin substrates.

Wc report on the development of silicon micromachining techniques for fabricating silicon-based waveguide circuits which can operate up to several THz. Both WR-10 (75 GHz - 115 GHz) and WR-4 (170 GHz - 260 GHz) waveguides have been fabricated from (1 10) silicon wafers. A potassium hydroxide solution is used to etch the waveguide channels. The high etching ratio of the (1 10):(111) crystal planes in silicon allow for channels with vertical sidewalls. Waveguide channels both with and without thin ($\approx 2\ \mu m$) silicon nit ride membranes in the Ii-plane have been produced. Low-temperature select ive metallizat ion techniques based on electroless plated nickel have been developed which coat the silicon waveguide walls but leave silicon nitride membranes untouched. Insert ion loss measurements have been made up to 260 GHz using a broadly tunable backward wave oscillator. The results show performance comparable to conventional metal waveguide (within $\pm$ 0.25 dB). These techniques will allow for the fabrication of complex, high-frequency waveguide components which would bc practically impossible by conventional techniques.

The research described in (his abstract was performed by the Center for Space Microelectronics Technology, Jet Propulsion Laboratory, and the Department of Electrical Engineering, California Institute of Technology, and was jointly sponsored by the National Aeronautics and Space Administration, Office of Space Access and Technology, and the JPL Director's Research and Discretionary Fund.

JET PROPULSION LABORATORY

NOTIFICATION OF CLEARANCE

11/01/95

TO: J. McNei 11

FROM : Documentation and Materiel Division

SUBJECT: Notification of Clearance - CL 95-1363

The following title has been cleared by the Document Review Services, Section 644, for public release, presentation, and/or printing in the open literature:

> Software Transition Project Retrospectives and the Application of SEL Effort Estimation Model and Boehm's Constructive Cost Model to Complex Software Transition Projects

This clearance is issued for an abstract and is valid only for release in the U.S.

Clearance issued by Mary Sue O'Brien

Mary Sue O'Brien
Document Review Services
Section 644

(Over)